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(56) Documents Cited
GB 2229189 A GB 2201376 A EP 0327788 A2
WO 89/00319 A US 4277774 A

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(54) Apparatus for reading security documents bearing photochromic or thermochromic prints.

(57) A security-marked document 10 carries an image in reversibly colour-changeable photochromic or thermochromic print and also carries an image in constant-colour print. An apparatus for reading the security markings comprises means (e.g. UV light 34) for acting upon the document to change the colour of the photochromic print, and means (e.g. camera 30) for viewing the document after the colour-change and to form electrical signals representing the image being viewed, so that the document can be verified. These image-representing signals may be compared with corresponding signals obtained by viewing the document before the colour-change is effected.

The colour-changeable print and the constant colour print may be in encoded form. A keyboard 40 may be used to input a PIN code into the image processing unit 32.

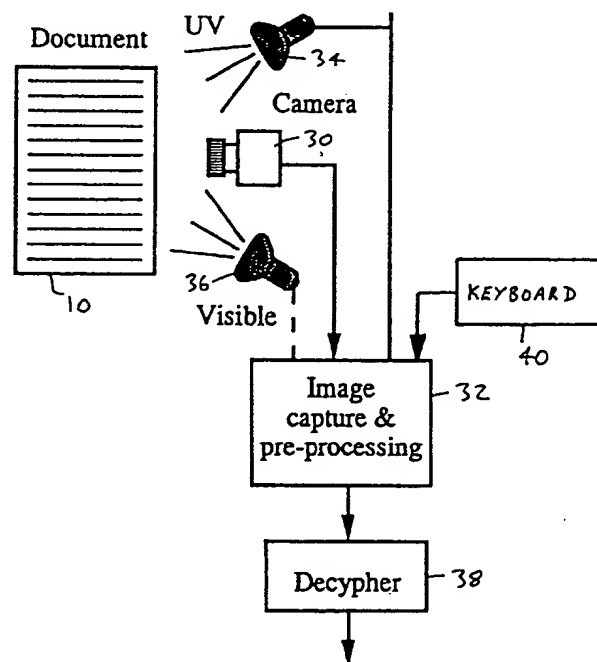


Figure 2

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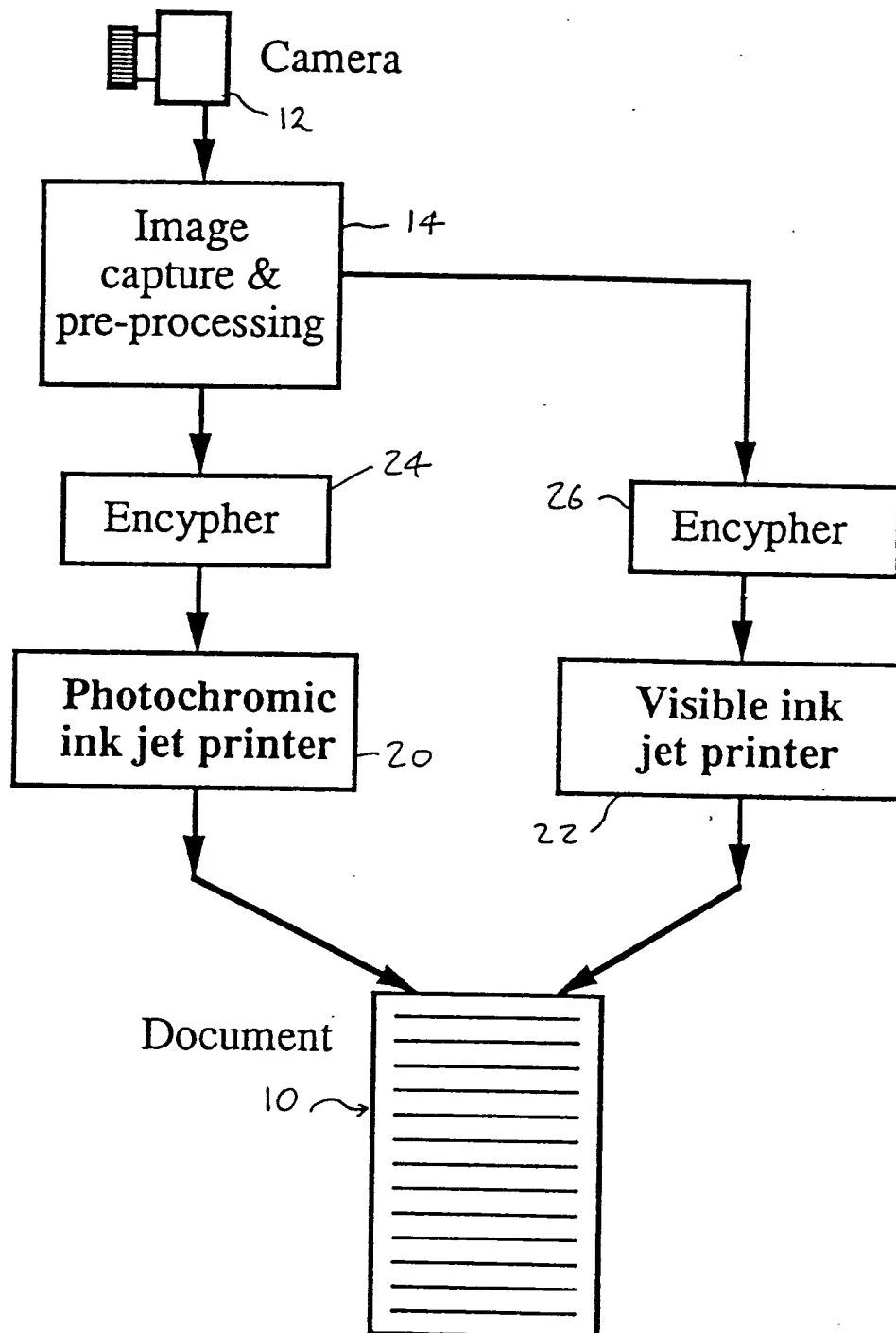


Figure 1

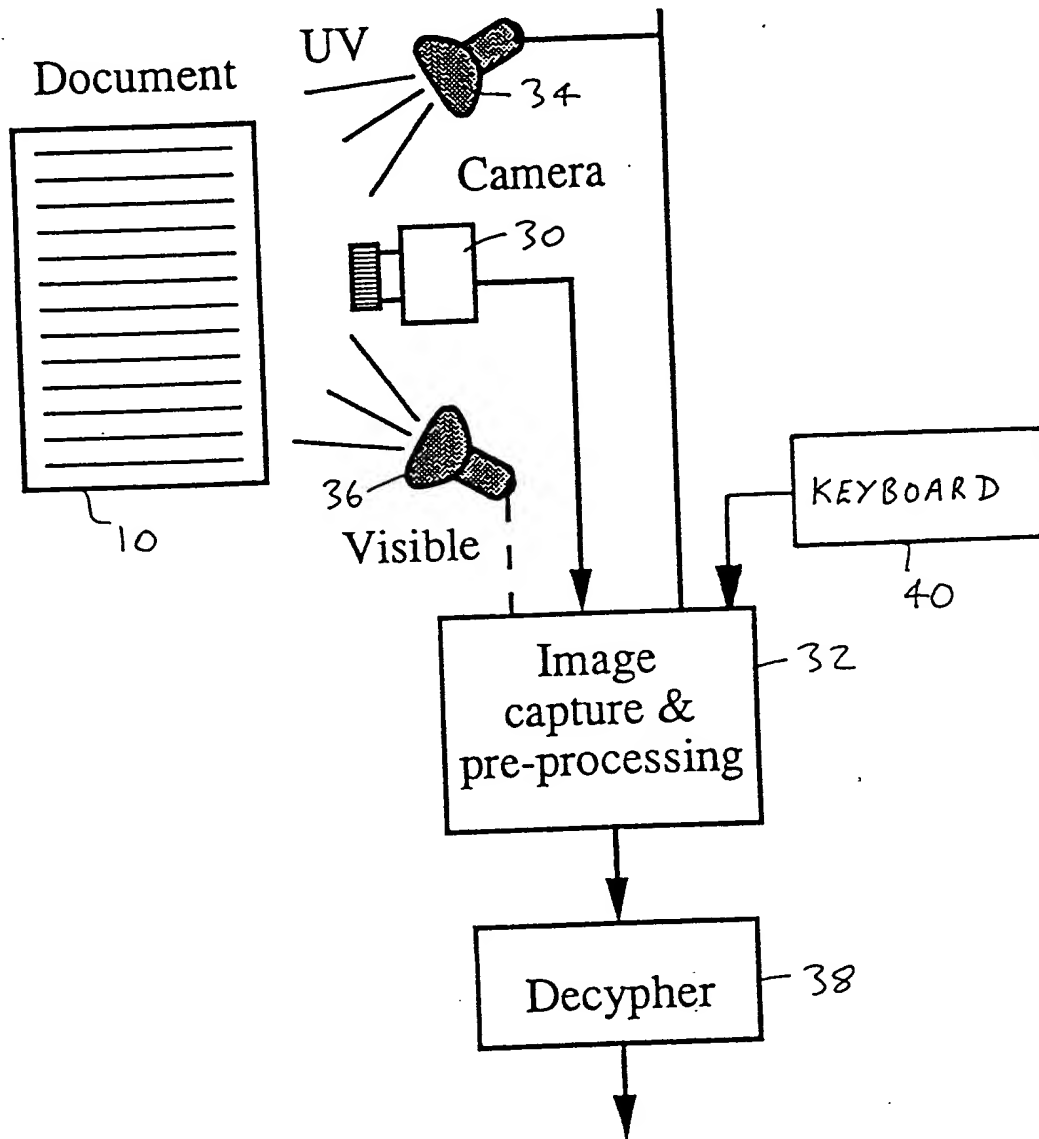


Figure 2

Documents with security markings

This invention relates to documents which carry security markings, to apparatus for forming such security markings on documents and to apparatus for reading such security markings from documents.

5 In this specification, the term "document" includes single-sheet articles such as tickets, banknotes, cheques, certificates and receipts and also includes cards e.g. credit cards and identification cards even though made of plastics or other materials rather than paper.

10 It is common for documents to carry markings in addition to normal human-readable printing, for the purposes of security. The markings may consist of a visible, machine-readable code such as a bar code. Such encoded markings must be read by machine in order that the document, or its holder,
15 can be verified. For example the encoding may identify or be personal to the holder of the document. The nature of the markings needs to be secure in order to prevent fraudulent copying.

We have now devised arrangements for forming security
20 markings on documents and for reading such markings.

In accordance with this invention, there is provided an apparatus for security-marking a document, comprising means for applying an image in reversibly colour-changeable photochromic or thermochromic print to the document and means for applying
25 an image in constant-colour print to the document.

The reversibly colour-changeable print which is applied to the document may be an encoded image. The constant-colour print which is applied to the document may also be an encoded image. The printing means may comprise or include ink jet or
30 other printers.

The apparatus may further comprise a viewing means (e.g. a video camera or document scanner) for directing at an object and forming electrical signals representing an image of the object: these electrical signals may then be encoded before
35 controlling the printing means.

Also in accordance with this invention, there is provided a document which carries an image in reversibly

colour-changeable photochromic or thermochromic print and also carries an image in constant-colour print.

For the reversibly colour-changeable print, photochromic inks or dyes may be used. Such inks or dyes can be switched from their normal or initial colour condition (typically colourless) to another colour by illuminating them, (typically with ultraviolet light: some photochromic inks or dyes can be switched back to their initial colour (photochemically bleached) by illumination with light of a different wavelength (typically in the visible spectrum): other photochromic inks or dyes fade back thermally to their initial colour at ambient temperatures.

Instead, for the reversibly colour-changeable print, thermochromic inks or dyes may be used. Such inks or dyes change from their initial colour to another colour when heated, and revert to their initial colour upon cooling.

Further in accordance with this invention, there is provided an apparatus for reading security markings from a document, comprising means for acting upon the document to change the colour of photochromic or thermochromic print carried by the document, means for viewing the document after said colour-change and to form electrical signals representing the image which is viewed, and means for processing the image-representing signals to verify the document.

Preferably this apparatus is arranged also to view the document either before the colour-change or after the print has returned to its initial colour condition, and to compare the data corresponding to the image when viewed under normal colour conditions and colour-changed conditions. In this way the apparatus forms a resultant corresponding to the photochromic or thermochromic image only (i.e. free of any constant-colour print on the document).

Embodiments of this invention will now be described by way of examples only and with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic diagram of an apparatus for applying images including security markings to a document; and

FIGURE 2 is a schematic diagram of an apparatus for

reading security markings from a document.

Referring to Figure 1, there is shown in schematic form an apparatus for printing or otherwise applying images to a document 10. The apparatus comprises a video camera, or document scanner 12 for viewing an object, and an image capture and pre-processing unit 14 for receiving the corresponding output signal from the camera or document scanner 12: the unit 14 digitises the signal from the camera, and pre-processes and stores this data. The apparatus further comprises two ink jet printers 20 and 22, one using a photochromic ink and the other using visible ink. The apparatus is arranged to encode an image held by unit 14, using encypher units 24 or 26, and control the ink jet printer 20 or 22 to print the encoded image onto the document 10. The same image may be separately encoded at 24 and 26 and these separately encoded images then printed onto the document by the respective ink jet printers. Alternatively, different images may be separately encoded at 24 and 26 and then printed. The printed document carries an image in the visible ink, which is of constant colour, and also carries an image in the photochromic ink, which is normally colourless and therefore not visible. As described so far, both of these images are encoded, but it may be instead that only the photochromic ink image is encoded.

Figure 2 shows an apparatus for reading the document 10. This apparatus comprises a video camera or document scanner 30 for viewing the document, and an image capture and pre-processing unit 32 for receiving the corresponding output signal from the camera or document scanner 30. The apparatus further comprises an ultraviolet (UV) light source 34 and a white light source 36. In use the document 10 is illuminated by the ultraviolet light so that its photochromic print will change to a visible colour: an image of the document under this condition is captured by the camera or document scanner 30 and stored in digital form. The document 10 is then illuminated by the white light source 36 until the photochromic print on the document changes back to its initial, invisible condition. An image of the document under this condition is captured by the camera or document scanner 30, either at this stage or

before its illumination by the ultraviolet light. The two images which are thus captured and stored can be compared or "subtracted" one from the other to provide a resultant corresponding to the photochromic ink images alone. This is then decyphered by an image processing unit indicated at 38.

For decyphering, the image processing may compare the photochromic print image, which has been read from the document 10, with stored references to determine whether the document is valid. Alternatively, the image processing may run a series of algorithms on the image data in order to verify the documents. The image processing can similarly be carried out on the visible print image, i.e. the image captured whilst the photochromic print is in its colourless condition.

In verifying the document, the image processing may also take account of a code, such as a personal identification number (PIN), entered separately on a keyboard 40, as indicated in Figure 2.

The use has been described of photochromic inks or dyes which can be switched from a normal or initial colourless condition to a coloured condition by illumination by ultraviolet light and can be switched back (photochemically bleached) by illumination by white light. Instead photochromic inks or dyes may be used which revert or fade back thermally to their initial colour condition, at ambient temperatures. Another option is to use thermochromic inks or dyes, which change from an initial colour condition to another when heated and which revert to their initial colour condition upon cooling: in this case the reading apparatus includes a heater for heating the document to induce the colour change.

CLAIMS

- 1) An apparatus for security-marking a document, comprising means for applying an image in reversibly colour-changeable photochromic or thermochromic print to the document, and means for applying an image in constant-colour print to the document.
- 2) An apparatus as claimed in claim 1, arranged to apply the colour-changeable print to the document as an encoded image.
- 3) An apparatus as claimed in claim 1 or 2, arranged to apply the constant-colour print to the document as an encoded image.
- 4) An apparatus as claimed in claim 2 or 3, further comprising viewing means for directing at an object and forming electrical signals representing an image of the object, and means for encoding said signals before applying them as control signals to a said image applying means.
- 5) An apparatus substantially as herein described with reference to Figure 1 of the accompanying drawings, for security-marking a document.
- 6) An apparatus for reading security markings from a document, comprising means for acting upon the document to change the colour of photochromic or thermochromic print carried by the document, means for viewing the document after said colour-change and to form electrical signals representing the image being viewed, and means for processing the image-representing signals to verify the document.
- 7) An apparatus as claimed in claim 6, arranged to view said document either before said colour-change or after the print has returned to its initial colour condition, and to compare said electrical signals representing said image when

viewed under normal colour conditions and colour-changed conditions.

8) An apparatus substantially as herein described with reference to Figure 2 of the accompanying drawings, for reading
5 security markings from a document.

9) A document which carries an image in reversibly colour-changeable photochromic or thermochromic print and which also carries an image in constant-colour print.

10) A document as claimed in claim 9, in which the
10 photochromic print is responsive to illumination with light of a selected wavelength to effect a reversible colour change.

11) A document as claimed in claim 9 and substantially as herein described.

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Patents Act 1977
Examiner's report to the Comptroller under Section 17
(The Search report)

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Relevant Technical Fields

Search Examiner
G J W RUSSELL

- (i) UK Cl (Ed.M) B6A (ATC)
(ii) Int Cl (Ed.5) B41M 3/14; G07D 7/00

Date of completion of Search
12 JANUARY 1994

Databases (see below)

- (i) UK Patent Office collections of GB, EP, WO and US patent specifications.

Documents considered relevant following a search in respect of Claims :-
1-11

(ii)

Categories of documents

- X: Document indicating lack of novelty or of inventive step. P: Document published on or after the declared priority date but before the filing date of the present application.
Y: Document indicating lack of inventive step if combined with one or more other documents of the same category. E: Patent document published on or after, but with priority date earlier than, the filing date of the present application.
A: Document indicating technological background and/or state of the art. &: Member of the same patent family; corresponding document.

Category	Identity of document and relevant passages		Relevant to claim(s)
X	GB 2229189 A	(DE LA RUE) - whole document	1,9,10
X	GB 2201376 A	(LIQUID CRYSTAL DEVICES) - see page 4 lines 19-32	1,9
X	EP 0327788 A2	(SICPA HOLDINGS) - whole document	1,9,10
X	WO 89/00319	(GLOBAL SECURITY) - see page 2 line 33 - page 3 line 5	1,2,9,10
X	US 4277774	(LAUREL BANK MACHINE) - see whole document	6,9

Databases: The UK Patent Office database comprises classified collections of GB, EP, WO and US patent specifications as outlined periodically in the Official Journal (Patents). The on-line databases considered for search are also listed periodically in the Official Journal (Patents).